Flow stabilization in submicron-sized copper crystals by introducing high angle boundaries

Zhang, Xiaodan; Huang, Xiaoxu; Hansen, Niels

Published in:
Abstract book - Materials Science & Technology 2013

Publication date:
2013

Document Version
Publisher's PDF, also known as Version of record

Controlled Synthesis, Processing, and Applications of Structural and Functional Nanomaterials — Session I

Program Organizers: Gurpreet Singh, Kansas State University; Kathy Lu, Virginia Tech; Eugene Olevsky, San Diego State University; Nitin Chopra, University of Alabama; Edward Gorzkowski, Naval Research Laboratory; Sanjay Mathur, University of Cologne

Monday PM
October 28, 2013

Room: 512f
Location: Palais des Congres de Montreal

Session Chairs: Kathy Lu, Virginia Tech; Gurpreet Singh, Kansas State University

2:00 PM Invited
Roughening Instability during Coating for Nanoscale Solution-derived Thin Films: *Dunbar Birnie*[1]; [1]Rutgers University

2:40 PM Invited
Self-assembled Semiconductor 0D, 1D and 2D Quantum Structures in a Nanowire for Advanced Bandgap Modulation: Growth, Structural Modeling and Optical Properties: María de la Mata[1]; Francisco Belarre[1]; *Jordi Arbiol*[1]; [1]ICREA and Institut de Ciencia de Materials de Barcelona, ICMAB-CSIC

3:20 PM Break

3:40 PM
Role of Catalyst Dissolution in Shaping VLS Grown Nanowires: *Dany Chagnon*[1]; Oussama Moutanabbir[1]; [1]Polytechnique Montréal

4:00 PM
Isotopically Engineered Silicon Nanowires: *Samik Mukherjee*[1]; Oussama Moutanabbir[1]; [1]Ecole Polytechnique de Montreal

4:20 PM Invited
Our Hair Reacts to a Charged Carpet or Static Electricity - So Does Nanomorphology in Organic Photovoltaic Films: The First Demonstration: Moneim Elshobaki[1]; *Sumit Chaudhary*[1]; [1]Iowa State University

5:00 PM Invited
Eight Two-Dimensional Transition Metal Carbides:
Adding Two New Members to the MXenes Family: Michael Naguib; J. Halim[1]; J. Lu[2]; L. Hultman[3]; Michel Barsoum; *Yuri Gogotsi*[4]; [1]Drexel University; [2]IFM Linkoping University; [3] IFM Linkoping University; [4]Drexel Univ

5:20 PM
Hybrid Aerogel/Nanorod Functional Materials for Energy and Sensing Applications: *Derek Miller*[1]; Pat Morris[1]; Sheikh Akbar[1]; [1]Ohio State University

5:40 PM
Growth of Binary and Ternary Tungsten Oxide Nanowires with Large Aspect Ratios for Smart Device Applications: Tao Sheng[1]; Baobao Cao[2]; *Haitao Zhang*[2]; [1]Department of Physics and Optical Science, UNC Charlotte; [2]Department of Mechanical Engineering and Engineering Science, UNC Charlotte

Deformation and Transitions at Grain Boundaries III — Mechanical Deformation and Failure of Grains and Grain Boundaries II

Program Organizers: Thomas Bieler, Michigan State University; Rozaliya Barabash, MST Div; Doug Spearot, University of Arkansas; Jian Luo, Sch Mat Sci & Engn, ; Shen Dillon, Dept Mat Sci & Engn

Monday PM
October 28, 2013

Room: 511f
Location: Palais des Congres de Montreal

Session Chairs: Fionn Dunne, Imperial College; Philip Eisenlohr, Michigan State University

2:00 PM Invited
Stresses near Grain Boundaries in Deformed Polycrystals: Jun Jiang[1]; T Britton[2]; *Angus Wilkinson*[1]; [1]University of Oxford; [2]Imperial College London

2:20 PM Invited
Changes in Deformation Resistance of Cu with Variations between Low and High-angle Dominated Grain Boundary Character: *Philip Eisenlohr*[1]; Jiri Dvorak[2]; Petr Kral[2]; Vaclav Sklenicka[2]; Wolfgang Blum[3]; [1]Max-Planck-Institut für Eisenforschung; [2]Academy of Sciences of the Czech Republic; [3]Universität Erlangen-Nürnberg

2:40 PM Invited
Flow Stabilization in Submicron-sized Copper Crystals by Introducing High Angle Boundaries: *Xiaodan Zhang*[1]; Xiaoxu Huang[1]; Niels Hansen[1]; [1]Technical University of Denmark

3:00 PM Invited
Characterization of Grain Boundary Effects on Material Damage Evolution: *John Bingert*[1]; Veronica Livescu[1]; Ricardo Lebensohn[1]; Brian Patterson[1]; Cheng Liu[1]; Thomas Mason[1]; [1]Los Alamos National Laboratory

3:20 PM Break

3:40 PM Invited
Micromechanics of Dislocation Channeling and IGSCC in Irradiated Stainless Steels: *Gary Was*[1]; Michael McMurtrey[1]; Ian Robertson[2]; Bai Cui[2]; Diana Farkas[3]; Laura Patrick[3]; [1]University of Michigan; [2]University of Illinois; [3]Virginia Tech

4:00 PM
Dislocation Density Distributions in Deformed Polycrystals: *Jun Jiang*[1]; T Britton[2]; Angus Wilkinson[1]; [1]University of Oxford; [2]Imperial College London

4:20 PM
Fracture Toughness of Nanocrystalline Ni-W Films: *Wanjun Cao*[1]; Yuanyao Zhang[2]; Jian Luo[2]; Richard Vinci[1]; [1]Lehigh University; [2]University of California, San Diego

4:40 PM Invited
Microstructure-sensitive Fatigue Crack Nucleation Criteria in Ferritic Steels: *Fionn Dunne*[1]; Victor Wan[1]; [1]Imperial College

5:00 PM Invited
Silicon Nitride-graphene Composites with Improved Strength and Toughness Processed from Low Concentrations of Few Layer Graphene Using SPS: Luke Walker[1]; Victoria Marotto[1]; Mohammad Rafiee[2]; Nikhil Koratkar[2]; *Erica Corral*[3]; [1]The University of Arizona; [2]Rensselaer Polytechnic Institute; [3]The University of Arizona

Flow stabilization in submicron-sized copper crystals by introducing high angle boundaries

Xiaodan Zhang, Xiaoxu Huang and Niels Hansen

Danish-Chinese Center for Nanometals, Materials Science and Advanced Characterization Section, Department of Wind Energy, Risø Campus, Technical University of Denmark, DK-4000 Roskilde, Denmark

The presence of high angle boundaries in a metal affects both the plastic behavior and the strength. This is explored in copper crystal pillars with sizes around 200nm prepared by focused ion beam. Pillar 1 is a single crystal while pillar 2 and pillar 3 contain one and three high angle boundaries, respectively. Low yield stress and large stress drops were observed in pillar 1, but small drops are present in pillar 2 and 3. The existence of high angle boundaries in pillar 2 and 3 removes the large stress drops by preventing the escape of dislocations from the pillar and the presence of these boundaries increases the stress of crystals 2-3 times. The significant effect of grain boundaries in the crystals is analyzed by combining the observation of microstructure, crystal rotation and strength as a function of the plastic strain.

References

[1] Xiaodan Zhang, Andrew Godfrey, Grethe Winther, Niels Hansen, Xiaoxu Huang. Plastic deformation of submicron-sized crystals studied by in-situ Kikuchi diffraction and dislocation imaging. Materials Characterization, 2012;70:21-27.

[2] Xiaodan Zhang, A Godfrey, Grethe Winther, Niels Hansen, Xiaoxu Huang. In-situ TEM compression of submicron-sized single crystal copper pillars. Risoe International Symposium On Materials Science. Proceedings 31. 2010. P. 489-496.